

of a *Pterygotus* (recognised by Dr. H. Woodward), now in the British Museum. The occurrence there of this characteristically Upper Silurian and Lower Old Red Sandstone genus supports the view contended for in this paper as to the true horizon of the Orkney and Caithness flagstones.

The Shetland Islands contain a portion of the shoreline of Lake Orcadie with its conglomerates and sandstones and the flagstones and shales of deeper water. Among these strata the Caithness *Estheria* occurs, with abundant stems and roots of large calamite-like plants with well-marked flutings but without observable joints. Some ichthyolites of the Caithness type are said to have been found in Bressay. The general lithological characters are quite those of the sandy parts of the Orkney and Caithness groups. On the west side of the mainland of Shetland interesting evidence occurs to show the existence of volcanic action contemporaneous with the accumulation of the Old Red Sandstone. Beds of amygdaloidal lavas and bands of tuff occur among the sandstones, the whole being pierced by masses of pink felsite.

The south-western and southern margin of this great northern basin of the Old Red Sandstone can still be traced nearly continuously from the confines of Caithness to the borders of Aberdeenshire, its position being marked by a zone of littoral conglomerates. Beyond the edge of that zone, however, there occur some interesting outliers which in some cases may represent long fjord-like indentations of the coast line; in others may mark what were really independent basins lying at the base of the Grampian Mountains. The author points out that probably most of the difficulty which has hitherto been experienced in understanding the sequence of beds along the southern shores of the Moray Firth and their parallelism with those of Caithness and Orkney is not to be attributed to the amount of detritus covering the country, but rather to the fact which has not heretofore been observed that the Upper Old Red Sandstone with *Holoptychius* and *Pterichthys major* really overlap unconformably upon the older nodular clays and conglomerates with *Coccosteus*, *Cheirolepis*, &c. This relation could be satisfactorily determined in Morayshire, and was now being worked out by Mr. John Horne in the course of the Geological Survey. The author traces in great detail from the Spey into Sutherlandshire, the development of the lower sandstone conglomerates and clays, which have been regarded as equivalents of the Caithness flagstones. He thinks that in no sense can this comparatively thin group of rocks (seldom 1,400 feet in depth) be regarded as a mere southward attenuation of the great Caithness series, as suggested by Murchison, for that neither lithologically nor palæontologically can that view be sustained. He has been led to the conclusion that the whole of these rocks from the borders of Sutherlandshire to those of Aberdeenshire represent only the higher portions of the great Caithness series, and that they were formed during a gradual depression of the ancient high grounds whereby the waters of Lake Orcadie were allowed to creep southward over the descending land. This movement is indicated by the character of the strata, and that it took place about the time of deposit of the later flagstones of Caithness is shown by the occurrence of the fossils of that division in the nodules, flags, and clays of the Moray Firth region, while those of the Lower division are absent.

Allusion is likewise made to the discovery of two localities where contemporaneous volcanic action has recently been observed in the Moray Firth area, the whole of the basin of Lake Orcadie being otherwise remarkably free from any trace of such action except on the northern margin in Shetland. The history of the area embraced by Lake Caledonia will form the subject of the next paper.

NOTES

WE regret to have to announce the death of Dr. F. Brügge-mann. Dr. Brügge-mann was a native of Bremen and studied at Jena, where he was for several years assistant to Prof. Haeckel. His earliest publications were on entomological subjects, but later he published an account of the Amphibians and Reptiles of Bremen. He was especially interested in ornithology, and amongst other papers on this subject published two on the Birds of South-Eastern and Central Borneo (*Abhand. d. naturw. Vereins zu Bremen*, Bd. v. u. vi.). On the recommendation of Prof. Haeckel, Dr. Brügge-mann was engaged last year by Dr. Günther to arrange and catalogue the collection of corals in the British Museum. Whilst in the midst of this undertaking he died suddenly at his lodgings on the night of Saturday last of hæmorrhage from the lungs. He had already named 1,500 species of corals in the collection, and had published two papers on undescribed forms in the *Annals and Magazine of Natural History*. He had in hand a revised list of all species of recent corals hitherto described, which was in an advanced state and which he had intended to have published. He was of an extremely amiable disposition and his loss is deeply regretted in London by the staff of the British Museum and other naturalists with whom he was acquainted. He was under thirty years of age at the time of his death.

ON Thursday last the members of the General Council summoned to deliberate upon the improvements required in the organisation of the Paris Observatory waited upon M. Bardoux, the Minister of Public Instruction. They insisted upon the necessity of continuing the existing connection between astronomy and meteorology in accordance with the principles established by M. Leverrier himself, and developed the reasons which had led the majority to pass a resolution in favour of that system. A number of eminent scientific men had interviews with M. Bardoux, and have made a strong impression upon his mind. M. Bardoux has ordered all the letters from a number of departmental meteorological commissions to be summarised, and it has been found that not a single one has urged the disconnection of the two departments. We are in a position to state that according to every probability, during the present month, the Academy of Sciences and the new Council of the Observatory will be summoned to present each two candidates, between whom the Minister will exert his right of selection according to the provisions of the newly-published decree.

CAPTAIN FEILDEN, R.A., naturalist to the late British Expedition to the Arctic Regions, and Mr. De Rance, of H.M. Geological Survey, are announced to read a paper on the Geology of the Northern Lands visited, at the next meeting of the Geological Society of London, at which Mr. Etheridge will present a detailed report of the palæontology of the same area. We understand that the British Museum will probably be the destination of the very numerous collection of geological specimens made by Capt. Feilden, Dr. Copping, and other officers of the expedition.

M. BELGRAND, Director of the Paris Sewers and Waterworks, died suddenly on the 8th inst. in his sixty-eighth year. To him Paris owes its network of sewers and its supply of water from the Dhuys, the Vanne, and the Somme Soude. He also devised the system of hydrological observations, by which floods are foreseen. As a connoisseur of water he is said to have had no rival.

It is stated that Prof. H. J. S. Smith, F.R.S., is to be a candidate for the representation of Oxford University in Parliament.

THE coloured spherules discovered by M. Hannover in the cones of the retina of many birds are known to have three colours: a yellowish green, an orange yellow, and an intense

ruby-red. Lately, M. Capranica affirmed the identity of these different colouring matters and their close relation to visual red and the widely expanded lutein (found in the yolk of egg, adipose tissue, corpora lutea, the ovary of mammalia, &c.), and he cited various reactions as proving this relation. M. Kuhne has lately, in the *Centralblatt für die medicin. Wiss.*, opposed this view; he has succeeded easily in isolating the three colouring matters after they were freed from fat, and he affirms that as regards spectroscopic behaviour, reaction, and solubility, they may be clearly distinguished.

THE French Academy had proposed for the prize of eloquence in 1877 the *éloge* of Buffon, the celebrated naturalist, and not less than seventeen memoirs were presented. Two were found so excellent that in opposition to the traditions of the Academy, they were declared *ex æquo*, as having obtained the premium. When the sealed envelopes containing the names of the authors were opened, it was found that one of them had died before he had quite revised his work. The name of this posthumous laureate is M. Narcisse Michaud. M. Dumas has written a letter of sympathy and regret to the family in the name of the Academy.

M. DE WATTEVILLE, one of the chief secretaries of the French Minister of Public Instruction, has lately submitted a plan for the formation of a large scientific committee in Paris, which shall stand in direct communication with all existing learned societies. The project will be put into execution during the present month, and M. Bardoux, the Minister of Public Instruction, will be the first president of the committee.

ON April 4 was held at the Tuileries a meeting of the several committees which had been appointed in order to organise the series of congresses intended to take place in Paris during the Universal Exhibition. After having returned thanks to his numerous subordinates for their exertions, the Minister for Public Works read a list of eleven congresses which are completely organised, viz.:—1. Agriculture. 2. Metrical and monetary, for the adoption of a universal system. 3. Special congress for determining a universal measure of threads of every description used in textile fabrics. 4. For the protection of literary, artistic, and industrial property, patents, &c., &c. 5. For provident institutions, life, fire, agriculture, &c., insurances. 6. Philological. 7. A congress inaugurated by European economists. 8. Meteorological. 9. The French Alpine Club will call a congress of every similar institution. 10. Public hygiene. 11. A congress for the international regulation of measures against the propagation of epizootics. Other congresses are in preparation. The several regulations will be published very shortly, mentioning the dates, the space of time allotted to them, the several programmes, the places of meeting, the conditions of admission, and the composition of initiative commissions.

HERR ACHENBACH, the Prussian Minister of Commerce, has lately issued an order that during the Paris Exhibition arrangements shall be made at the Berlin School of Mines to put at the service of those desiring to study the mineral wealth of the kingdom, all possible cartographical and literary requisites, as well as information as to the best means of reaching all points of interest in the mining regions; this disposition is made more especially for the benefit of American scientific visitors in recognition of the courtesies extended by them in this direction two years ago.

A GUIDE for the approaching Exhibition at Paris has just been published under the title "Guide de l'Exposition Universelle et de la Ville de Paris." (Paris: Bureau de la Publicité.) It contains no less than fifty-four maps and plans.

THE Institute of Naval Architects commences its annual session to-day; the meetings will be continued to-morrow and

Saturday. A large number of papers on subjects of great importance are down for reading.

THE agents of the Paris Acclimatisation Society are engaged in organising, at Marseilles, a zoological garden which will be considered as an annexe to the Parisian establishment. A certain number of animals have already arrived but have not yet been placed in the cages which are being built for them.

A PAPER on "State Aid to Music at Home and Abroad" was read by Mr. Alan S. Cole, at the Society of Arts on Wednesday evening, March 27. Allusion was made to the constitution of foreign Conservatoires, which, to a considerable extent, depend upon the support given to them by the governments of the countries in which they are established. Government support gives an element of stability to these foreign Conservatoires, and Mr. Cole endeavoured to show that in the United Kingdom there is an absence of stability in respect of the different music schools which exist. Our academies and schools of music have been founded by private enterprise, and their existence, depending upon the fluctuations of subscriptions and amateur fee-paying students, seems to have no guarantee of permanence. In regard to freely established classes for promoting science and art, the prospect of their becoming permanent is assisted by the offer of national payments for ascertained results of instruction. In elementary day schools the education department makes a payment of one shilling per child who attends a school where singing is taught. These shilling payments amount to 96,000*l.* a year. As, however, the Inspector of Music, Mr. John Hullah, reports that the musical proficiency of the children is bad, it may be inferred that not only is the instruction of the children in music bad, but the payment also of so large a sum as 96,000*l.* per annum is of little use in securing for national benefit an adequate return. The supply of duly qualified teachers in the art and science of music may probably tend to diminish the disproportion between the annual expenditure and the insufficient return of results in musical instruction. Accepting the general features common to Conservatoires abroad as the outlines for similar institutions at home, Mr. Cole called attention to the Royal Academy of Music and to the New National Training School for Music at Kensington. The Royal Academy is not a Conservatoire according to the definition given. The constitution of the National Training School is similar to that of the chief Conservatoires. The tendency of individual or private enterprise seems to direct itself towards the training of singers and performers; and it was stated that the Kensington School was at present training nearly a hundred scholars of this class. The duty of the Government is to provide qualified teachers, the results of whose instruction shall be of value to the country at large, and therefore properly to be paid for out of the exchequer. The form of State aid which it was suggested might be given was the payment of the fees of instruction of a certain number of students whose aim is to be teachers in elementary schools, in local classes, and music schools throughout the country. Such payment of fees would be made to that academy or training school whose proved methods of instruction seemed to be the best, and the work promoted by this kind of State aid would not compete with that part of national culture which is at present dependent upon the support given according to the whims of the givers, and therefore of an uncertain, spasmodic, unbusiness-like character.

M. CAZIN, the eminent French physicist, whose premature death we noticed a few months since, left a manuscript on Spectrum Analysis. This has just been published by Gauthier Villars in his "Actualités Scientifiques."

THE Annual Meeting of the Cumberland Association for the Advancement of Literature and Science will be held at Cockermouth on Easter Monday and Tuesday. A varied and interesting

programme is arranged for the two days, one of the items being a lecture by Sir George Airy on "The Probable Condition of the Interior of the Earth."

FOR Easter Monday and following day the Geologists' Association have arranged what promises to be an interesting excursion to Chipping Norton. Provincial field societies are now also issuing programmes of their summer excursions; the Manchester Field Naturalists and the Leeds Naturalists have sent us well-arranged programmes of this kind.

EXCAVATIONS in the neighbourhood of Merten, in Lorraine, have uncovered the remains of an old Roman temple, and brought to light a variety of weapons, busts, coins, &c. The indications all point to the existence of a large settlement here under the Roman rule, and arrangements have been made for a series of widely extended excavations.

THE archæologists of Rome are busied over the latest discovery, the uncovering of a cellar containing a thousand vessels for various commercial purposes, two hundred of which are covered with inscriptions throwing no small light on the business terms of the ancient Romans.

IN the course of a report, which has just been published by order of the Inspector-General of Maritime Customs in China, Dr. F. Wong gives us some curious particulars respecting a strange remedial agent employed by the Chinese in cases of *Cynanche Tonsillaritis*. The disease they term *Ngo-how*, or "Goose-throat," and the remedy in question is called *How-tsao*, a soft stone not unlike biliary calculus in appearance. It is expensive, being worth twenty times its weight in silver, and is said to come from Siam. Twenty or thirty grains of this in powder, taken in water, is thought to be very efficacious. Dr. Wong mentions having seen a case where this remedy was given, and where it certainly appeared effective, after gargles and astringents had been applied in vain. The specimens of the stone which have come under his notice appear like animal concretions, and are of various sizes, some being smaller than pigeons' eggs, while others are as large as hens' eggs. The story goes that, when a monkey is wounded, the animal, from its natural instinct, picks out the proper medicinal herbs, masticates and applies them to the wound, so that successive layers are in this way laid on so as to form a mass. In time the wound heals, and the lump of dried herbs falls off; it is then picked up by the Siamese, found by them to possess peculiar virtues, and sent in small quantities to China as a drug.

News from Berlin states that Prof. Mommsen has again started upon a scientific expedition to the south of Italy, from which he intends to return to Berlin at the end of May.

IN the south of France no rain or snow has fallen since the beginning of the winter, and the prevailing drought resulting from this peculiar absence of atmospheric moisture has well-nigh assumed the proportions of a real catastrophe. The authorities have been obliged to take in hand the distribution of drinking water to the inhabitants. Between Marseilles and the Italian frontier certain railway stations are completely without water, and waggon-cisterns had to be constructed which are kept filled by water brought by train. The soil in the district is so hard that all agricultural work is impossible, and the crops are, of course, in a most miserable condition.

FROM Leipzig and its vicinity heavy rains are reported causing severe inundations in that neighbourhood.

DR. A. HARTMANN describes in the *Proceedings* of the Berlin Physiological Society for the present year, a new application of the telephone for the purpose of testing the hearing. It rests upon the fact that when the magnet of the receiving instrument is excited by a galvanic stream, the intensity of the tone transmitted can be altered at will by the introduction of various

resistances or of Du Bois-Reymond's compensator into the circuit. By this means it is easy to measure comparatively in different persons the limits of hearing, by applying the telephone to the ear, and noticing the amount of resistance necessary in order to extinguish the same sound.

THE American Chemical Society closes its second year with a membership of 300. Its *Transactions*, instead of appearing at irregular intervals, are to be published twice a month, and efforts are being made to concentrate in them all that America produces in the line of chemical research. The Society has chosen Prof. Johnson, the familiar authority on agricultural chemistry, for its president during 1878, and has elected to honorary membership Professors Frankland and Williamson, of London, Bunsen and Wöhler of Germany, Berthelot of Paris, Boutlerow of St. Petersburg, and Cannizzaro of Rome.

AN earthquake was felt at Liesthal, in the canton of Bâle during the night of March 28-29. This phenomenon was probably connected with another commotion which was registered at Strasburg Observatory by Winnecke, and was observed on March 29 at 8h. 52m. 27s. in the morning. The duration of the commotion was only $\frac{1}{3}$ s., and would have escaped notice if a registering apparatus had not been kept at the observatory. A violent earthquake was felt at Kaltenbrunn, in the Kaunser Valley (Tyrol) on March 16 at 5 A.M.

MR. A. O. THORLACIUS, the observer for the Scottish Meteorological Society at Stykkisholm, in the north-west of Iceland, reports the occurrence, on March 4, of the severest thunderstorm ever experienced in that part of Iceland. Thunder and lightning continued without interruption from 5.30 A.M. to 8 A.M., accompanied at intervals with rain and hail. For the past thirty-three years, during which Mr. Thorlacius has observed, nearly all the thunderstorms have occurred during the winter months. At 7 A.M. a very fine meteor passed over the village of Stykkisholm and exploded into innumerable fragments over the harbour, unaccompanied, however, with any audible report, and shortly after another fine meteor passed over the village and disappeared without being observed to explode. It is added that this is the first time such meteors have been observed by any one at Stykkisholm.

WITH regard to the fact stated by M. Forel, that frequently during distinct shocks of earthquake, the lakes show neither waves nor *seiches*, while at other times shocks produce large movements, M. De Rossi writes to *La Nature*, from Rome, that the lakes probably act according to the law of pendulums. Thus in Italy shocks of earthquake have frequently occurred without the pendulum seismograph showing any sign of movement, whereas, again, the pendulum may swing violently without the shock being perceived by any one. M. De Rossi has, with others, experienced a distinct shock of earthquake, and on immediately examining with a microscope eight pendulums of different lengths, could not detect the slightest motion. The fact evidently depends, he says, on the relation between the length of the pendulum and the rapidity of the earth-vibrations. When the seismic wave is *synchronous* with the natural oscillation of the pendulum, the latter enters into motion; when it is *dissynchronous*, the pendulum refuses to move.

It will be seen from our advertising columns, that pending the erection of the permanent buildings of the Channel Islands' Zoological Station, St. Helier's, Jersey, arrangements have been made for placing private rooms with tables and apparatus at the disposal of a limited number of naturalists and students, with every assistance in obtaining subjects for investigation.

THE additions to the Zoological Society's Gardens during the past week include two Persian Gazelles (*Gazella subgutturosa*) from Persia, presented by Mr. R. W. Inglis; a Macaque

Monkey (*Macacus cynomolgus*) from India, presented by Mr. Francis Pym; a Common Squirrel (*Sciurus vulgaris*), European, presented by Madame Hante; a Vulpine Phalanger (*Phalangista vulpina*) from Australia, presented by Capt. F. Ayling; a Pudu Deer (*Cervus humilis*), a Naked-eared Deer (*Cervus gymnotis*) from Chili, a Maned Goose (*Bernicla jubata*) from Australia, purchased; an Egyptian Gazelle (*Gazella dorcas*) from Egypt, deposited; a Frazer's Squirrel (*Sciurus fraseri*) from Ecuador, a Black Sternothera (*Sternotherus niger*) from West Africa, received in exchange.

UNDERGROUND TEMPERATURE¹

OBSERVATIONS on a very elaborate scale have been received from the important mining district of Schemnitz, in Hungary. A request for observations was sent by the Secretary, in 1873, to the Imperial School of Forests and Mines at Schemnitz, and on the receipt of two thermometers a Committee was formed to plan and carry out observations. The leading part in the observations has been taken by Dr. Otto Schwartz, Professor of Physics and Mathematics, who has furnished an elaborate report of the results obtained. This is accompanied by a geological report drawn up by Prof. Gustav von Liskay and by a geological map with plans and sections of the mines.

The two thermometers sent being deemed insufficient for the numerous observations which were contemplated, twenty-five large thermometers were ordered from a local maker (T. T. Greiner), and the ten best of these, after being minutely compared with one of the two thermometers sent—which was non-registering and had a Kew certificate—were devoted to the observations. Three of them were divided to tenths and the others to fifths of a degree Centigrade, and all had bulbs of thick glass to ensure slowness of action. They were found not to change their indications during the time requisite for an observation.

The observations were for the most part taken by boring a hole in the rock to a depth in the earlier observations of 422, and in the later ones of 79 of a metre, then filling the hole with water, and after leaving it in some cases for a few hours, in others for several days, to plunge a thermometer to the bottom of the hole, and after thirty or forty-five minutes take it out and read it. The tenths of a degree were read first, and there was time for this to be done before the reading changed. As a rule three observations were taken in each gallery, two of them in bore-holes to give the temperature of the rock, and the third in the air of the gallery at an intermediate position. Pyrites and also decaying timber were avoided as being known to generate heat, and as far as possible currents of air and the neighbourhood of shafts were avoided also.

A table, which forms part of Dr. Schwartz's report, contains observations made in no fewer than thirty-eight galleries. Besides the temperatures, it gives the depth of the place of observation beneath the shaft-mouth and the height of the latter above sea-level. Dr. Schwartz takes exception to a few of the observations in the table, as being vitiated by the presence of pyrites or by currents of air.

All the galleries mentioned in the table are classified according to the shafts with which they are connected, and there are for the most part six of these galleries to each shaft. In the final reductions, Dr. Schwartz compares the temperature in the deepest gallery of each shaft with the assumed mean annual temperature of the ground at the shaft-mouth. For determining this latter element the following data are employed.

The mean temperature of the air at the School of Mines, from twenty years' observation, is 7°·2 C. at the height of 612·6 metres above sea-level. The shaft-mouths are at heights of from 498 to 763 metres above sea-level, and it is assumed that the temperature of the air falls 1° C. for 100 metres of elevation. It is further assumed that the mean temperature one metre deep in the soil is, in these particular localities, 1° C. higher than the mean temperature of the air. The reasons given for this last assumption may be thus summarised:—

1. Observations in various localities show that in sandy soils the excess in question amounts on the average to about half a degree Centigrade.

2. In this locality the surface is a compact rock which is highly

heated by the sun in summer and is protected from radiation by a covering of snow in winter; and the conformation of the hills in the neighbourhood is such as to give protection against the prevailing winds. Hence the excess is probably greater here than in most places, and may fairly be assumed to be double of the above average.

Omitting one shaft (Franz shaft), in which, owing to the presence of pyrites, the temperatures are abnormal, the following are the principal results:—

	Depth in metres.	Increase of temp. Cent.	Quotient, or metres per 1° C.	Feet per 1° F.
Elizabeth shaft	417	8·5	49·1	89·5
Maximilian „	253	6·4	39·5	72·0
Amalia „	285	8·1	35·2	64·2
Stefan „	218	7·2	30·3	55·2
Siglisberg „	414	8·1	51·1	93·2
Sums, &c.	1587	38·3	41·4	75·5

The best mode of combining the results from these five shafts is indicated in the last line of the above table, where the sum of the depths is compared with the sum of the increments of temperature. We have thus a total increase of 38°·3 C. in 1,587 m.; which is at the rate of 1° C. in 41·4 m., or 1° F. in 75·5 feet.

As these results depend on an assumption regarding the surface-temperature, it seems desirable to check them by a comparison of actual observations, namely, by comparing the deepest with the shallowest observation in each mine. We thus obtain the following results:—

	Difference of depth, metres.	Difference of temperature, Cent.	Quotient metres per deg. Cent.	Feet per deg. Fahr.
Elizabeth shaft	145·2	4·6	31·6	57·6
Maximilian „	191·6	3·9	49·1	89·5
Amalia „	228·2	5·1	44·8	81·7
Stefan „	82·0	4·7	17·4	31·7
Siglisberg „	400·3	8·0	50·0	91·2
Sums, &c.	1047·3	26·3	39·8	72·5

Combining these results in the same manner as the others, we have a total difference of 26°·3 C. in 1047·3 metres, which is at the rate of 1° C. in 39·8 metres, or 1° F. in 72·5 feet.

The near agreement of this result with that obtained from comparison with the assumed surface-temperature is very satisfactory. The mean of the two would be 1° F. in 74 feet.

The rocks consist, for the most part, of trachyte and greenstone.

Dr. Schwartz concludes his report with the suggestion that the heat developed by the decomposition of pyrites and galena in seams which are not altogether air-tight and water-tight, may possibly be utilised as a guide to the whereabouts of metallic lodes; and that “we shall thus obtain, by means of the thermometer, scientific information which the ancients sought by means of the divining-rod.”

Thanks are due to M. Antoine Péch, Ministerial Councillor, and Director of the Mines, and to Herr Edouard Pöschl, Director of the School, for energetic co-operation in this extensive and valuable series of observations.

Mr. Lebour, having been requested to supplement the above *résumé* of the Schemnitz observations by an account of the connection (if any) between the geological and thermal conditions of the several mines, as indicated by a comparison of the reports of Dr. Schwartz, and Prof. von Liskay, remarks:—

“The rock at all the mines except Franzschacht is green

¹ Report of the British Association Committee on Underground Temperature, by Prof. Everett.